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Large Hadron Collider  
Magnet Division Procedure

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Title: D2 & D4 Magnet Final Assembly

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#### REVISION RECORD

Rev. No.	Date	Page	Subject	Approval
A	3/26/03		Initial Release	
B	7/25/03		Changes per ECN MG2152	
C	3/31/04		Changes per ECN MG2170	

1            Scope:

This procedure describes the steps for final assembly & electrical testing of LHC D2 & D4 magnets.

2            Applicable Documents:

14060007	Magnet Assembly (D2)
14060009	Magnet Assembly (D4)
RHIC-MAG-Q-1004	Discrepancy Reporting Procedure
<a href="#">RHIC-MAG-R-7242</a>	<a href="#">Hypot Testing</a>
<a href="#">RHIC-MAG-R-7243</a>	<a href="#">Low Precision Resistance/Continuity/ Insulation Test.</a>
<a href="#">RHIC-MAG-R-7320</a>	<a href="#">Electrical Resistance Measurement for Coils</a>
<a href="#">RHIC-MAG-R-7228</a>	<a href="#">Magnet Coil Inductance and Q Measurements</a>
<a href="#">LHC-MAG-R-1051</a>	<a href="#">Electrical Testing of Level &amp; Temperature Sensors</a>

3            Requirements:

3.1          Material/Equipment:

None

3.2          Safety Precautions:

3.2.1        All lifting of the cryostatted magnet shall to conform to Appendix A.

3.2.2        The technicians shall be instructed by their cognizant technical supervisor in the operation of the required electrical test equipment and the electrical testing procedures. They shall be familiar with the latest revisions of the applicable documents referenced in section 2. In addition, some of these tests require the technician to have special training.

3.2.3        Some of the electrical test procedures have specific safety requirements. The technicians performing these specific tests shall rigorously follow all the safety requirements listed as well as those prescribed by the BNL ES & H Standard.

3.2.4        Hypot testing poses a Class "C" electrocution hazard. At least two properly trained technicians must be present to perform this testing. When testing, a trained technician shall be stationed at any point where the item under test is accessible to unauthorized people, and barriers shall be set up. Signs shall be posted reading "DANGER HIGH VOLTAGE" and warning lights shall be turned on.

4 Procedure

4.1 Final Electrical Checks

**CAUTION**

**During all Hypot operations in this section, ensure that the leads for the Temperature Sensors and Level Probes are connected to ground.**

**NOTE**

**Reference Table 1 for identification of Pin ID's in Feedthrough Connector Box**

- 4.1.1 Connect both beam tubes, all quench protection resistors & iron to each other and to ground. Connect all coils together and perform 5 kV Hypot between coils and ground per RHIC-MAG-R-7242 and RHIC-MAG-R-7243.

**NOTE**

**The leakage current must be less than 50  $\mu$ a.**

- 4.1.2 Connect both beam tubes, all coils & iron to each other and to ground. Perform 5 kV Hypot between each of two quench protection resistor circuits and ground per RHIC-MAG-R-7242.

**NOTE**

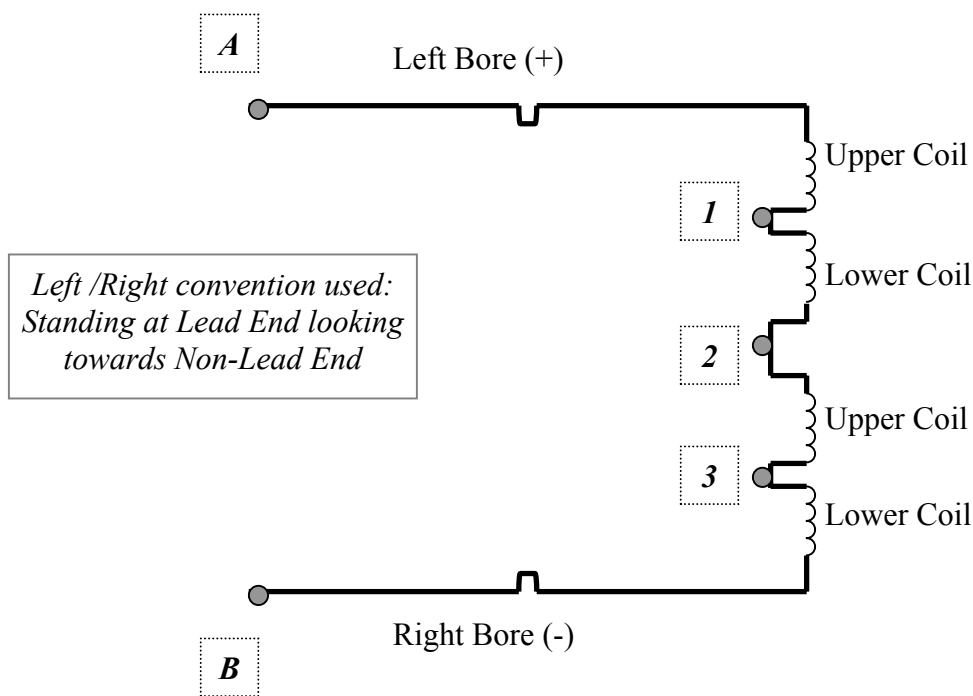
**The leakage current must be less than 50  $\mu$ a.**

- 4.1.3 Connect both beam tubes, all coils, iron & quench protection resistors to each other and to ground. Perform 2 kV Hypot between each warm-up heater circuit and ground per RHIC-MAG-R-7242.

**NOTE**

**The leakage current must be less than 50  $\mu$ a.**

- 4.1.4 Perform DC resistance tests per RHIC-MAG-R-7320 to measure voltage drops across the entire magnet winding and the voltage drop across each individual coil. Perform measurements using regular and redundant voltage taps individually.



*Limits:*

<b>A (+):</b>	<b>6.3722 – 7.0430 <math>\Omega</math></b>
<b>1:</b>	<b>4.7815 – 5.2848 <math>\Omega</math></b>
<b>2:</b>	<b>3.1915 – 3.5275 <math>\Omega</math></b>
<b>3:</b>	<b>1.5980 – 1.7662 <math>\Omega</math></b>
<b>B (-):</b>	<b>N/A</b>

- 4.1.5 Perform complete RLQ measurements per RHIC-MAG-R-7228.

*Limits:*

<b>Resistance:</b>	<b>6.3722 – 7.0430 <math>\Omega</math></b>
<b>L:</b>	<b>45.67 - 47.54 mH</b>
<b>Q:</b>	<b>2.31 – 2.55</b>

- 4.1.6 Perform resistance test between normal and redundant voltage tap wire at each point.

*Limits:*

**Resistance to be 320  $\Omega$  - 480  $\Omega$**

- 4.1.7 Perform resistance test on each of two Quench Protection Resistor circuits.

*Limits:*

**Resistance: 5.4 – 6.6  $\Omega$**

- 4.1.8 Perform resistance test on each of two Warm-Up heater circuits.

*Limits:*

**Resistance: 95 – 105  $\Omega$**

- 4.1.9 Perform resistance check of Level Probes as noted in LHC-MAG-R-1051.

- 4.1.10 Perform resistance check of Temperature Sensors as noted in LHC-MAG-R-1051.

## 4.2 Lead Labeling

- 4.2.1 Remove any temporary labels from leads. Add permanent labels according to convention noted below:

Lead "A": Connection to Upper Coil

Lead "B": Connection to Lower Coil

*Reference is Interface Specification LHC-MBR-ES-0003.00*

## 4.3 Cryostat Labeling

- 4.3.1 Apply decal with BNL logo as shown on assembly drawing.

- 4.3.2 Complete all information on cryostat nameplates using metal stamps. Leave the "manufactured date" blank.

- 4.3.3 Obtain date of "Acceptance Certificate" from the Magnet Division Magnet Acceptance Committee. Affix this date to the cryostat nameplate as the "Manufactured Date".

5            Quality Assurance Provisions

- 5.1            The Quality Assurance provisions of this procedure require that all assembly and test operations be performed in accordance with the procedural instructions contained herein.
- 5.2            Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.
- 5.3            All discrepancies shall be identified and reported in accordance with RHIC-MAG-Q-1004.

Table 1 - Pin ID's in Feedthrough Connector Box

Description	Connector & Pin ID ( on box )	Feedthrough ID
Level Probe - NLE - A	C32-4	LT821 I-
Level Probe - NLE - A	C32-3	LT821 I+
Level Probe - NLE - A	C32-2	LT821 U-
Level Probe - NLE - A	C32-1	LT821 U+
Level Probe - NLE - B	C32-8	LT822 I-
Level Probe - NLE - B	C32-7	LT822 I+
Level Probe - NLE - B	C32-6	LT822 U-
Level Probe - NLE - B	C32-5	LT822 U+
Level Probe - LE	C32-12	LT823 I-
Level Probe - LE	C32-11	LT823 I+
Level Probe - LE	C32-10	LT823 U-
Level Probe - LE	C32-9	LT823 U+
Quench Protection Circuit A	P31-2	YT311 I-
Quench Protection Circuit A	P31-1	YT311 I+
Quench Protection Circuit B	P31-4	YT312 I-
Quench Protection Circuit B	P31-3	YT312 I+
V-Tap Bore A – Low	D30-5	EE151
V-Tap Bore A – Low	P30-1	EE152
V-Tap Bore A – High	D30-1	EE111
V-Tap Bore A – High	D30-2	EE112
V-Tap Bore A – Mid	D30-3	EE131
V-Tap Bore A – Mid	D30-4	EE132
V-Tap Bore B – Low	D30-9	EE251
V-Tap Bore B – Low	D30-10	EE252
V-Tap Bore B – High	P30-2	EE211
V-Tap Bore B – High	D30-6	EE212
V-Tap Bore B – Mid	D30-7	EE231
V-Tap Bore B – Mid	D30-8	EE232
Warm-Up Heater Circuit A	C31-2	EH821 I-
Warm-Up Heater Circuit A	C31-1	EH821 I+
Warm-Up Heater Circuit B	C31-4	EH822 I-
Warm-Up Heater Circuit B	C31-3	EH822 I+
Yoke Temperature Sensor A	C30-4	TT821 I-
Yoke Temperature Sensor A	C30-3	TT821 I+
Yoke Temperature Sensor A	C30-2	TT821 U-
Yoke Temperature Sensor A	C30-1	TT821 U+
Yoke Temperature Sensor B	C30-8	TT822 I-
Yoke Temperature Sensor B	C30-7	TT822 I+
Yoke Temperature Sensor B	C30-6	TT822 U-
Yoke Temperature Sensor B	C30-5	TT822 U+

## Appendix A - Lifting Scheme for Cryostatted D2 & D4 Magnet

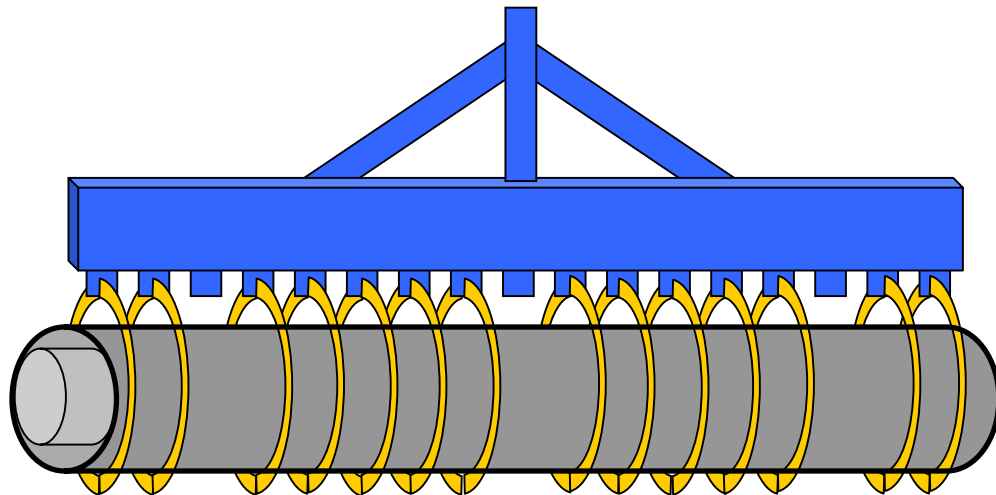
### CAUTION

**Weight of D2 /D4 Magnet Assembly exceeds rating of the Lifting Beam (BNL Dwg. 25-1782.02). Use of this device is permitted to lift the D2 & D4 Magnet Assembly only if load is equally distributed on 14 of 17 lifting lugs (center lug and lugs 3 from each end are not used).**

### NOTE

**QQS Assembly does not have a significant effect on the units center of gravity. Care must be taken to avoid interference with the QQS Assembly**

Use 14 slings and Lifting Beam 25-1782.02 as shown below to move the magnet assembly.



Magnet Assembly Rigging